wherein at least one of the following conditions is satisfied:

$(d_1/2)(D_1/2)/(\lambda \cdot f) \geq 3.05$

$(d_2/2)(D_{21}/2)/(\lambda \cdot f) \geq 3.05$

where f is a focal length of each of said micro optical elements, d_1 is a length of one side of the entrance surface of each of said micro optical elements, d_2 is a length of the other side of the entrance surface of each of said micro optical elements, D_1 is a length of the side of an exit surface in each of said micro optical elements corresponding to said one side of the entrance surface, D_2 is a length of the side of the exit surface in each of said micro optical elements corresponding to said other side of the entrance surface, and λ is a wavelength of said incident beam.--

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--54. (New) An optical integrator according to claim 53, wherein each of said micro optical elements has a micro lens.--

--55. (New) An optical integrator according to claim 54, wherein the length d_1 of said one side of the entrance surface is longer than the length d_2 of said other side of the entrance surface, and wherein the condition:

$(d_1/2)\ (D_1/2)/(\lambda \cdot f) \geq 3.05$

is satisfied.--

--56. (New) A wavefront dividing type optical integrator, comprising:

a plurality of micro optical elements arranged two-dimensionally, for forming a plurality of light sources by dividing a wavefront of an incident beam,

wherein each of said micro optical elements has a rectangular entrance surface and a circular or a regular hexagonal exit surface, and

wherein at least one of the following conditions is satisifed:

$(d_1/2)(D/2)/(\lambda \cdot f) \geq 3.05$

$(d_2/2)(D/2)/(\lambda \cdot f) \geq 3.05$

where f is a focal length of each of said micro optical elements, d_1 is a length of one side of the entrance surface of each of said micro optical elements, d_2 is a length of the other side of the entrance surface of each of said micro optical elements, D is a diameter of the circular exit surface or a diameter of a circle circumscribing the regular hexagonal exit surface of each of said micro optical elements, and λ is a wavelength of said incident beam.--

--57. (New) An optical integrator according to claim 56, wherein each of said micro optical elements has a micro lens.--

--58. (New) An optical integrator according to claim 57, wherein the length d_1 of said one side of the entrance surface is longer than the length d_2 of said other side of the entrance surface, and wherein the condition:

$$(d_1/2)(D/2)/(\lambda \cdot f) \geq 3.05$$

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is satisfied.--

--59. (New) A wavefront dividing type optical integrator, comprising:

a plurality of micro optical elements arranged two-dimensionally, for forming a plurality of light sources by dividing a wavefront of an incident beam,

wherein each of said micro optical elements has a circular entrance surface with a diameter of d, or a regular hexagonal entrance surface inscribed in a circle having a diameter of d,

wherein each of said micro optical elements has a circular exit surface with a diameter of d, or a regular hexagonal exit surface inscribed in a circle having a diameter of d, and

wherein the following condition is satisifed:

$$(d_1/2)2/(\lambda \cdot f) \geq 3.05$$

where f is a focal length of each of said micro optical elements, and λ is a wavelength of said incident beam.--

--60. (New) An optical integrator according to claim 59, wherein said micro optical elements have a micro lens.--

--61. (New) An illumination optical apparatus for illuminating a surface to be irradiated with a beam from a light source, said illumination optical apparatus comprising:

the optical integrator according to claim 54, disposed in an optical path between said light source and said surface to be irradiated, for forming a plurality of light sources based on the beam from said light source; and

a light-guiding optical system, disposed in an optical path between said optical integrator and said surface to be irradiated, for guiding beams from a plurality of light sources formed by said optical integrator to said surface to be irradiated.--

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--62. (New) An illumination optical apparatus according to claim 61, wherein said light-guiding optical system comprises:

a condenser optical system disposed in the optical path between said optical integrator and said surface to be irradiated, for condensing said beams from said light sources formed by said optical integrator so as to form an illumination field in a superposing manner; and

an image forming optical system, disposed in the optical path between said condenser optical system and said surface to be irradiated, for forming an image of said illumination field near said surface to be irradiated with a beam from said illumination field.--

--63. (New) An illumination optical apparatus according to claim 62, wherein said light-guiding optical system comprises:

an aperture stop, disposed in an optical path of said image forming optical system at a position substantially optically conjugate with a position where said plurality of light sources are formed, for blocking an unnecessary beam.--

--64. (New) An illumination optical system according to claim 61, wherein each of said micro lens in said optical integrator has at least one refractive surface formed into an aspheric form which is symmetrical about an axis parallel to a reference optical axis.--

--65. (New) An illumination optical system according to claim 64, wherein said optical integrator has a number of combining optical systems whose optical axes are respective axes parallel to said reference optical axis,

at least one refractive surface formed aspheric being formed into a predetermined aspheric surface in order to favorably restrain coma from occurring in said combining optical systems.--

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--66. (New) An illumination optical system according to claim 64, further comprising:

a filter, disposed near the entrance side of said optical integrator, having a predetermined optical transmissivity distribution which contributes to correct an unevenness in illumination on said surface to be irradiated; and

a positioning sub-system, connected to said optical integrator and said filter, for positioning said optical integrator and said filter with respect to each other.--

--67. (New) An illumination optical system according to claim 64, wherein an iris stop adapted to change the size of an opening portion is disposed adjacent the exit surface of said optical integrator.--

--68. (New) An illumination optical system according to claim 64, wherein said optical integrator has at least two optical element bundles disposed along said reference optical axis with a gap therebetween,

at least two of said optical element bundles having said aspheric optical surface.--

--69. (New) An illumination optical system according to claim 68, wherein at least two of said optical element bundles have a number of combining optical systems each

comprising at least two micro optical elements corresponding to each other along said axis, all optical surfaces in said combining optical systems being formed into aspheric surfaces having properties identical to each other.--

--70. (New) An illumination optical system according to claim 68, further comprising:

a positioning sub-system, connected to at least two of said optical element bundles, for positioning at least two of said optical element bundles with respect to each other.--

--71. (New) An illumination optical system according to claim 64, wherein said optical integrator has at least 1,000 axes.--

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--72. (New) An illumination optical system according to claim 61, comprising a light source image enlarging member, disposed in an optical path between said optical integrator and said light source at or near a position conjugate with said surface to be irradiated, for enlarging said light source images.--

--73. (New) An illumination optical system according to claim 72, wherein a beam divergent angle of said light source image enlarging member is determined such that no loss in illumination light occurs in said optical integrator.--

--74. (New) An illumination optical system according to claim 73, wherein said optical integrator has a plurality of lens surfaces, arranged two-dimensionally, each forming said light source image,

wherein said light source image enlarging member enlarges said light source image formed by said lens surface, and

wherein said beam diverging angle of said light source image enlarging member is set such that said enlarged light source image is smaller than said lens surface.--

--75. (New) An illumination optical system according to claim 72, wherein said optical integrator has a plurality of lens surfaces, arranged two-dimensionally, each forming said light source image.--

--76. (New) An illumination optical system according to claim 72, wherein a substantially uniform illuminance distribution is formed in a near field of said light source image enlarging member.--

--77. (New) An illumination optical system according to claim 72, wherein only one pattern is formed in a far field of said light source image enlarging member.--

--78. (New) An illumination optical system according to claim 72, wherein said far field pattern of said light source image enlarging member is circular, elliptical, or polygonal.--

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--79. (New) An illumination optical system according to claim 72, wherein said illumination optical system forms a secondary light at a pupil thereof, and

wherein said secondary light source having an optical intensity distribution in which the optical intensity in a pupil center region including an optical axis in a region on said pupil is set lower than that in a region surrounding said pupil center region is formed.--

--80. (New) An illumination optical system according to claim 72, further comprising a diffractive optical element, disposed in an optical path between said light source and said optical integrator, for controlling said optical intensity distribution of said secondary light source.--

--81. (New) An illumination optical system according to claim 80, comprising a zeroth-order light blocking member, disposed in an optical path between said diffractive optical element and said optical integrator, for blocking a zeroth-order light from said diffractive optical element.--

--82. (New) An illumination optical system according to claim 81, wherein said optical integrator comprises:

a plurality of lens surfaces arranged two-dimensionally; and

an entrance-side cover glass disposed on the entrance side of said plurality of lens surfaces, and

said entrance-side cover glass being provided with said zeroth-order light blocking member.--

--83. (New) An illumination optical system according to claim 72, wherein said light source image enlarging member has a diffractive optical element or diffuser.--

--84. (New) An illumination optical system according to claim 83, wherein an anti-reflection film with respect to a wavelength of said illumination light is disposed on a surface of said diffractive optical element or diffuser.--

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--85. (New) An illumination optical system according to claim 72, wherein said optical integrator comprises:

a plurality of lens surfaces arranged two-dimensionally; and

an exit-side cover glass disposed on the exit side of said plurality of lens surfaces,

wherein said exit-side cover glass has a light-shielding member provided on the exit-side cover glass for blocking light passing through a region different from said plurality of lens surfaces toward said surface to be irradiated.--

--86. (New) An illumination optical system according to claim 72, further comprising a micro fly's eye lens disposed in the optical path between said light source and said surface to be irradiated,

wherein said micro fly's eye lens comprises a substrate having a surface formed with a plurality of lens surfaces, and

wherein said lens surfaces of said micro fly's eye lens have an anti-reflection film, provided on the lens surfaces and said micro fly's eye lens, with respect to said illumination light.--

--87. (New) An illumination optical system according to claim 72, comprising an illuminance distribution correcting member, disposed between said light source and said optical integrator, for controlling respective intensity distributions of Fourier-transformed images of said plurality of light source images independently from each other.--

--88. (New) An illumination optical system according to claim 87, said optical integrator comprises:

a plurality of lens surfaces arranged two-dimensionally;

an entrance-side cover glass disposed on the entrance side of said plurality of lens surfaces; and

an exit-side cover glass disposed on the exit side of said plurality of lens surfaces,

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wherein said illuminance distribution correcting member is disposed in an optical path between said entrance-side cover glass and said exit-side cover glass.--

--89. (New) An illumination optical system according to claim 72, wherein said illumination optical apparatus forms an illumination area on said surface to be irradiated, said illuminance region having a form whose length in a predetermined direction differs from that in a direction orthogonal to said predetermined direction.--

--90. (New) An illumination optical system according to claim 84, wherein said anti-reflection film has at least one ingredient selected from: aluminum fluoride; barium fluoride; calcium fluoride; cerium fluoride; cesium fluoride; erbium fluoride; gadolinium fluoride; hafnium fluoride; lanthanum fluoride; lithium fluoride; magnesium fluoride; sodium fluoride; cryolite; chiolite; neodymium fluoride; lead fluoride; scandium fluoride; strontium fluoride; terbium fluoride; thorium fluoride; yttrium fluoride; ytterbium fluoride; samarium fluoride; dysprosium fluoride; praseodymium fluoride; europium fluoride; holmium fluoride; bismuth fluoride; a fluorine resin comprising at least one material selected from the group including: polytetrafluoroethylene; polychlorotrifluoroethylene; polyvinyl fluoride;

fluorinated ethylene propylene resin; polyvinylidene fluoride; and polyacetal; aluminum oxide; silicon oxide; germanium oxide; zirconium oxide; titanium oxide; tantalum oxide; niobium oxide; hafnium oxide; cerium oxide; magnesium oxide; neodymium oxide; gadolinium oxide; thorium oxide; yttrium oxide; scandium oxide; lanthanum oxide; praseodymium oxide; zinc oxide; lead oxide; a mixture group and a complex compound group comprising at least two materials selected from a group of silicon oxides; a mixture group and a complex compound group comprising at least two materials selected from a group of hafnium oxides; and a mixture group and a complex compound group comprising at least two materials selected from a group of aluminum oxides.--

--91. (New) An illumination optical system according to claim 72, wherein said light source supplies illumination light having a wavelength of 200 nm or shorter.--

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--92. (New) An illumination optical system according to claim 91, wherein said diffractive optical element or said micro fly's eye lens has a silica glass doped with fluorine.--

--93. (New) An illumination optical system for illuminating a surface to be irradiated with a beam from a light source, said system comprising:

a plurality of optical elements disposed in an optical path between said light source and said surface to be irradiated; and

a positioning sub-system, connected to said at least one of said optical elements, for positioning said at least one of the optical elements.--

--94. (New) An illumination optical system according to claim 93, wherein at least one of said optical elements includes a plurality of optical surfaces arranged two-dimensionally.--

--95. (New) An illumination optical system according to claim 94, wherein a positioning sub-system aligns said optical surfaces arranged two-dimensionally and another optical element among said plurality of optical elements.--

--96. (New) An illumination optical system according to claim 93, wherein said positioning sub-system optically aligns said at least one of the optical elements.--

--97. (New) An illumination optical system according to claim 96, wherein said positioning sub-system is disposed outside the optical path between said light source and said surface to be irradiated.--

--98. (New) An illumination optical apparatus for illuminating a surface to be irradiated with illumination light from a light source, and apparatus comprising:

a micro fly's eye lens, disposed in an optical path between said light source and said surface to be irradiated, having a substrate with a surface formed with a plurality of lens surfaces; and

a condenser optical system, disposed in an optical path between said micro fly's eye lens and said surface to be irradiated, for guiding a beam from said micro fly's eye lens toward said surface to be irradiated,

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wherein said lens surfaces of said micro fly's eye lens has an anti-reflection film, disposed on said lens surfaces, with respect to said illumination light.--

--99. (New) An illumination optical apparatus for illuminating a surface to be irradiated with illumination light from a light source, said apparatus comprising:

a micro fly's eye, disposed in an optical path between said light source and a surface to be irradiated, having a substrate with a surface formed with a plurality of lens surfaces;

a condenser optical system, disposed in an optical path between said micro fly's eye lens and said surface to be irradiated, for guiding a beam from said micro fly's eye lens toward surface to be irradiated; and

an exit-side protecting member, disposed in an optical path between said micro fly's eye lens and said condenser optical system, formed from a material transparent to said illumination light,

wherein said exit-side protecting member has a light-shielding member, provided on said exit-side protecting member, for blocking light passing through a region different from said plurality of lens surfaces of said micro fly's eye lens toward said surface to be irradiated.--

--100. (New) An illumination optical apparatus according to claim 99, further comprising an entrance-side cover glass disposed in an optical path between said light source and said micro fly's eye lens.--

--101. (New) An illumination optical apparatus, adapted to be combined with a photolithographic exposure apparatus comprising a projection optical system for forming a pattern of a first surface onto a second surface, for illuminating said first surface with a beam from a light source, said illumination optical apparatus comprising:

a multiple beam superposing member, disposed in an optical path between said light source and said first surface, for dividing said beam from said light source and for superposing divided beams onto an illumination field which is a region on a predetermined surface; and

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an illumination image forming optical system, disposed in an optical path between said multiple beam superposing member and said first surface, for forming an image of said illumination field on or near said first surface,

wherein said illumination image forming optical system has an aperture stop disposed at a position optically conjugate with a pupil of said projection optical system.--

--102. (New) An illumination optical apparatus according to claim 101, wherein said aperture stop blocks only an unnecessary light which causes flare.--

--103. (New) An exposure apparatus for projecting a pattern of a mask onto a photosensitive substrate,

said exposure apparatus comprising the illumination optical apparatus according to claim 61,

wherein said surface to be irradiated is set on said photosensitive substrate.--

--104. (New) An exposure apparatus for transferring a pattern on a first surface onto a second surface, comprising:

an illumination optical apparatus according to claim 64 for illuminating said first surface; and

a projection optical apparatus, disposed in an optical path between said first surface and said second surface, for projecting said pattern onto said second surface,

wherein said illumination optical system further comprises an optical intensity distribution changing member, disposed in an optical path between said light source and said optical integrator, for changing an optical intensity distribution of a beam incident on said optical integrator.--

--105. (New) An exposure apparatus illuminating a mask formed with a pattern with an illumination light in a predetermined wavelength range so as to form an image of said pattern onto a substrate by way of a projection optical system,

said exposure apparatus comprising the illumination optical apparatus according to claim 72 for supplying said illumination light to said mask.--

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--106. (New) An exposure apparatus according to claim 105, wherein an illumination area on said mask has a form whose length in a predetermined direction differs from that in a direction orthogonal to said predetermined direction, and

wherein exposure is carried out while changing a relative relationship between said mask and said illumination area.--

--107. (New) An exposure method in which a mask formed with a pattern is illuminated with illumination light in a predetermined wavelength range so as to form an image of said pattern onto a substrate by way of a projection optical system,

wherein said illumination light is supplied to said mask by use of the illumination optical apparatus according to claim 72.--

--108. (New) An observation apparatus for forming an image of an object to be observed, said observation apparatus comprising:

the illumination optical apparatus according to claim 56 for illuminating said object to be observed; and

an image forming optical system, disposed between said object to be observed and said image, for forming an image of said object to be observed according to a light having traveled by way of said object to be observed.--

--109. (New) An illumination optical apparatus for illuminating a surface to be irradiated with illumination light from a light source, said apparatus comprising:

an optical integrator, disposed in an optical path between said light source and said surface to be irradiated, for forming a secondary light source based on a beam from said light source;

a condenser optical system, disposed in an optical path between said optical integrator and said surface to be irradiated, for guiding a beam from said optical integrator toward the surface to be irradiated; and

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a diffractive optical element, disposed in an optical path between said light source and said surface to be irradiated,

wherein said diffractive optical element has a surface which is provided with an anti-reflection film with respect to said illumination light.--

--110. (New) An illumination optical system according to claim 109, wherein said anti-reflection film has at least one ingredient selected from: aluminum fluoride; barium fluoride; calcium fluoride; cerium fluoride; cesium fluoride; erbium fluoride; gadolinium fluoride; hafnium fluoride; lanthanum fluoride; lithium fluoride; magnesium fluoride; sodium fluoride; cryolite; chiolite; neodymium fluoride; lead fluoride; scandium fluoride; strontium fluoride; terbium fluoride; thorium fluoride; yttrium fluoride; ytterbium fluoride; samarium fluoride; dysprosium fluoride; praseodymium fluoride; europium fluoride; holmium fluoride;

bismuth fluoride; a fluorine resin comprising at least one material selected from the group including: polytetrafluoroethylene; polychlorotrifluoroethylene; polyvinyl fluoride; fluorinated ethylene propylene resin; polyvinylidene fluoride; and polyacetal; aluminum oxide; silicon oxide; germanium oxide; zirconium oxide; titanium oxide; tantalum oxide; niobium oxide; hafnium oxide; cerium oxide; magnesium oxide; neodymium oxide; gadolinium oxide; thorium oxide; yttrium oxide; scandium oxide; lanthanum oxide; praseodymium oxide; zinc oxide; lead oxide; a mixture group and a complex compound group comprising at least two materials selected from a group of silicon oxides; a mixture group and a complex compound group comprising at least two materials selected from a group of hafnium oxides; and a mixture group and a complex compound group comprising at least two materials selected from a group of aluminum oxides.--

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--111. (New) An illumination optical system according to claim 98, wherein said anti-reflection film has at least one ingredient selected from aluminum fluoride; barium fluoride; calcium fluoride; cerium fluoride; cesium fluoride; erbium fluoride; gadolinium fluoride; hafnium fluoride; lanthanum fluoride; lithium fluoride; magnesium fluoride; sodium fluoride; cryolite; chiolite; neodymium fluoride; lead fluoride; scandium fluoride; strontium fluoride; terbium fluoride; thorium fluoride; yttrium fluoride; ytterbium fluoride; samarium fluoride; dysprosium fluoride; praseodymium fluoride; europium fluoride; holmium fluoride; bismuth fluoride; a fluorine resin comprising at least one material selected from the group including: polytetrafluoroethylene; polychlorotrifluoroethylene; polyvinyl fluoride; fluorinated ethylene propylene resin; polyvinylidene fluoride; and polyacetal; aluminum oxide; silicon oxide; germanium oxide; zirconium oxide; titanium oxide; tantalum oxide; niobium oxide; hafnium oxide; cerium oxide; magnesium oxide; neodymium oxide; gadolinium oxide; thorium oxide; yttrium oxide; scandium oxide; lanthanum oxide; praseodymium oxide; zinc oxide; lead oxide; a mixture group and a complex compound group comprising at least two materials selected from a group of silicon oxides; a mixture